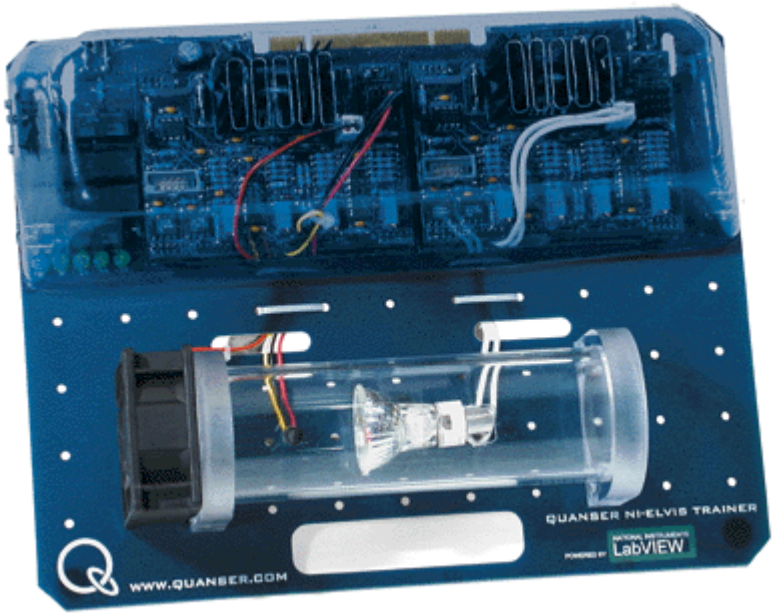
Quanser NI-ELVIS Trainer (QNET) Series:

QNET HVAC

Heating, Ventilation, and Air Conditioning (HVAC) User Manual



User Manual

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1. Introduction

The Quanser National Instruments Engineering Trainer (QNET) is a versatile and powerful training tool. Amongst its many capabilities, the QNET series of trainers allows for PC based control using the LABVIEW programming language, a National Instruments E-Series or M-Series data acquisition card, and an ELVIS workstation. The QNET allows for a scalable laboratory setup utilizing the ELVIS workstation platform.

The Heating, Ventillation, and Air Conditioning Trainer QNET module is designed to operate on the NI-ELVIS platform. The ELVIS unit is connected to an NI E-Series or M-Series data acquisition card inside the PC. The Labview program interacts with the data acquisition card to read two inputs – chamber temperature and ambient temperature – and control the output voltage to the heating halogen light and the cooling fan.

2. Requirements

The following system is required to complete the Heating, Ventillation, and Air Conditioning Trainer laboratory:

PC equipped with an NI-E Series or NI-M-Series data acquisition card connected to an NI ELVIS station.
Quanser QNET-012 Heating, Ventillation, and Air Conditioning Trainer (HVACT) module.
ELVIS CD installed for required drivers
LabView 7.1 with the following add-ons installed:
- Control Design Toolkit
- Simulation Module

3. References

[1] *NI-ELVIS User Manual*.
[2] *QNET LabView Controllers*
[3] *QNET Experiment #05: HVAC System Identification*
[4] *QNET Experiment #06: HVAC PI Temperature Control*
[5] *QNET Experiment #07: HVAC ON/OFF Temperature Control*

4. HVAC Plant Presentation

4.1. Component Nomenclature

As a quick nomenclature, Table 1, below, provides a list of the principal elements composing the Heating, Ventilation, and Air Conditioning (HVAC) Trainer system. Every element is located and identified, through a unique identification (ID) number, on the HVAC plant represented in Figure 1, below.

ID #	*Description*	*ID #*	*Description*
1	Heater / Halogen Lamp	**2**	Blower / Fan
3	Temperature Sensor	**4**	Chamber / Duct

Table 1 HVAC Component Nomenclature

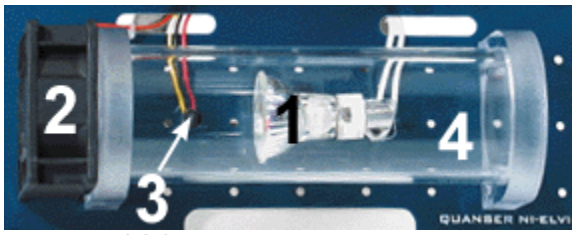

Figure 1 HVAC System

4.2. HVAC Plant Description

The QNET-HVAC Trainer system consists of a pexiglass duct, or chamber, equipped with a heater on one end and a blower on the other. A thermistor is placed in between at the location in the chamber where the temperature is to be controlled. The heater is made of a 12-Volt halogen lamp. The blower is a 24-Volt variable-speed fan.

The input voltage of the halogen light should NOT be set over 6-Volts at any time even though it is rated at 12-Volts. The heat radiated from the bulb can be harmful to some components in the HVAC module.

5. HVAC Module Setup

Section 5.1 explains how to setup the HVACT module on the ELVIS unit and properly initialize the system. The LabView controllers associated with the HVACT QNET module are overviewed in Section 5.2.

5.1. ELVIS and HVACT Module Setup Procedure

The QNET modules are designed to quickly and easily plug into the ELVIS prototype board slot and be ready for operation. Please configure the HVACT system for use with the LabView virtual instruments by following the steps below.

Step 1. **Do NOT make the following connections while power is supplied to the hardware, even when the *Standby Switch* on the rear panel of the NI ELVIS Benchtop Workstation is switched to OFF.**

Step 2. Install the QNET HVAC board by completing the following steps:

a) Position the large opening in the QNET board, over the mounting bracket on the NI ELVIS benchtop workstation. Note that some ELVIS workstations do not have the mounting brackets.

b) Slide the PCI connector of the QNET module end into the female connector of the NI ELVIS workstation, as shown in Figure 2.

c) Gently rock the board to ease it into place. It may be a tight fit, but do not force the board into place. The QNET board should now slide into the board bracket.

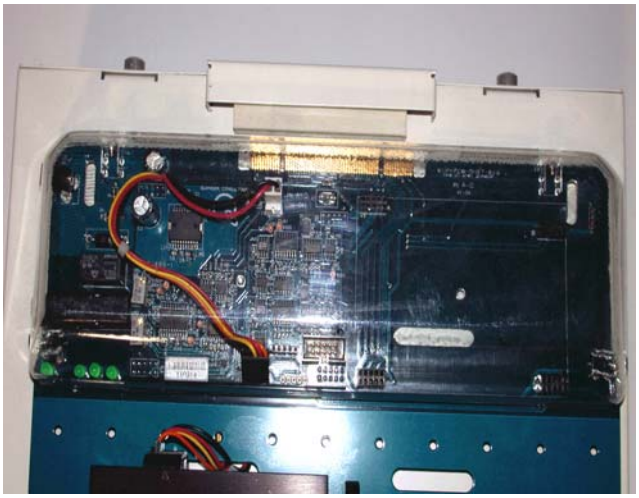

Figure 2 Fasten QNET Module onto ELVIS

Step 3. Connect the AC-DC wall transformer supplied with the ELVIS system to the corresponding input on the back panel of the NI ELVIS Benchtop Workstation.

Step 4. Connect the power cord to the AC-DC transformer and plug the power cord into the wall outlet.

Step 5. Similarly to power the QNET module, connect the AC-DC wall transformer that was provided with the QNET module to its bulk power jack, as shown in Figure 3.

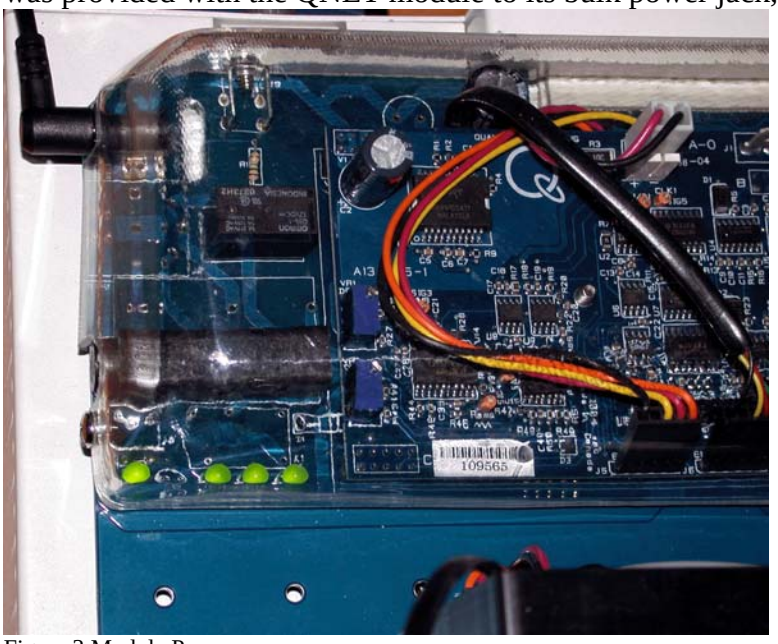

Figure 3 Module Power

Step 6. Connect the power cord to the QNET wall transformer and plug the power cord into the wall outlet.

Step 7. Before powering up the system, ensure the *Prototyping Board Power* switch is set to the OFF position and the *Communications* switch is set to the *BYPASS* mode.

Step 8. Power the NI ELVIS Benchtop Workstation by turning the *Standby Switch* on the rear panel of the system to ON.

Step 9. The *System Power* and *Communications* LEDs situated on the front panel of the NI ELVIS unit, as shown in Figure 4, should be lit. As depicted in Figure 3, verify also that the +15V,-15V, and +5V LEDs on the QNET module are lit. They indicate that the board has been properly connected to the ELVIS unit.

Figure 4 ELVIS Front Panel Power Switch

Step 10. Turn ON the *Prototyping Board Power* switch on the front panel of the NI ELVIS workstation. The *Prototyping Board* LED on the ELVIS front panel should turn bright green, see Figure 4, and the bulk power LED labeled as *+B* on the QNET module board should be bright green as well, as shown in Figure 3. The on-board amplifier that drives the motor is now powered.

⚠ **Turn OFF the *Prototyping Board* switch if the heater or fan go ON!** Any voltage applied by analog output channels #0 and #1 is amplified and delivered to the motor. Take extra care when powering the QNET module to avoid causing any damage to the halogen light and/or fan.

Step 11. The hardware setup is complete and you are now ready to load a given LabView virtual instrument and interact with the QNET module.

5.2. HVACT LabView Controllers

There are two Quanser LabView Virtual Instruments supplied with the QNET-HVACT module:

QNET_HVACT_Lab_05_System_ID.vi
QNET_HVACT_Lab_06_PI_Control.vi
QNET_HVACT_Lab_07_ON_OFF_Control.vi

The first Quanser LabView virtual instrument is used to identify the heating and ventilation modeling parameters and its associated laboratory manual is *QNET Experiment #05: HVAC System Identification* . The second Quanser LabView VI implements a PI controller to control the temperature inside the chamber and its corresponding manual is *QNET*

Experiment #06: HVAC PI Temperature Control . In the third Quanser LabView VI a more practical on/off controller is used to regulate the chamber temperature and its accompanying laboratory manual is *QNET Experiment #07: HVAC ON/OFF Temperature Control*. See QNET LabView Controllers guide for a general explanation on the challenges involved in the HVACT control laboratories.